arcadian

VOLUME ONE July 20, 1979 Number 8

PROGRAMMABLE KEYBOARD is still up in the air with nothing new to report in that area. I have received some positive responses to my query on projects in work, having to do with adding a keyboard and with adding memory - if there are any more workers out there, please let me know. I am now thinking that it would probably be a good idea to consider a backup plan in case the Bally output is delayed even more. This plan would provide us with a full size keyboard and added memory, but without the GRAFIX or ZGRASS features. This would come about by the concentrated effort of a number of subscribers who currently are working independently on either a keyboard or memory addition. With a common goal in mind, coordination of effort among the individuals, and probably a deadline (Jan 80), we should be able to progress faster than we are now. One important question is cost, and I am going to ask for a show of hands on the following which will enable us to determine the amount of memory capability that can be incorporated plus other 'goodies'.

1. Assume that the Bally Keyboard is available with full capacity (ref. p. 21). Are you ready to pay 650. for it?
2. Assume that the Bally Keyboard is available with partial capacity (ref. p.54). Are you ready to pay 350. for it?
3. Assume that we develop a keyboard that would have 16K RAM with upgrading capability to 24+ RAM, and some form of resident BASIC in 16K ROM, along with some features as cassette motor control, word processing capability, etc., Are you ready to pay 350. for it?(Assuming that Bally does not produce in the same time frame.)

A postal card with numbers down the side and yes/no opposite each is all that is necessary, but suggestions are certainly welcome. Also, tell me Model Number and Serial Number of your machine if you haven't done so yet.

INPUT DOUBLING has been reported by Kirk Gregg. He notes that you can include as many as 36 variables in an INPUT statement, separated by commas. That way you can INPUT A,B,O,U, @(9),@(6),etc., saving a few bytes.

DIRECT OPERATION of equipment is one of my pet goals for this machine. Some time back Mitt Nodacker sent me a scheme for detecting a specific tone output of the tone generator using a phase lock loop (PLL) decoder. This device listens for a tone of specific frequency and creates an output when the tone is detected. The output can then drive another device. The circuits are covered in such documents as: FM AND REPEATERS, by ARRL, p.120; INTEGRATED CIRCUIT PROJECTS Vol 3 by Radio Shack,p.57; or INTEGRATED CIRCUIT PROJECTS by Sams,ch.3., all using the NE567 PLL device and a few resistors/capacitors. I tried the circuit without any success, but a letter from Rich DeLong and Dan Zielinski stated that a frequency counter is most useful, so maybe I was just out of adjustment. But along with their letter came a similar circuit with a two-step amplifier and relay with which they have had success . I'll work on this and give you a report next time.

TRUTH of a statement can be directly displayed by the use of the PRINT command, reports Marc Gladstein. This is an adjunct to the IF discussions of pp. 52 + 53, where the machine decides if a statement is true (1) or false (ɸ). The answer can be displayed, if you are interested, as follows:

```
PRINT 1 = 2      display  ɸ
PRINT 3 = 3      display  1
PRINT 1 ≠ 2      display  1
PRINT 5 > 6      display  ɸ
```

TUTORIAL #1. Some material for the beginner in programming and computer usage.

First off, the machine is ignorant, totally ignorant with no imagination. It works only when you tell it to, and it only does what you tell it to do. It will do nothing by itself, or arbitrarily.
Everything that you tell it to do must be done in a step-by-step fashion. There are a couple of short-cuts available, but in general you must state everything that must be done and in the order in which it must be done.
As an example of the machine's 'dumbness', it won't do anything if you key in a command on the keypad. All that happens is that the screen will show the keys that were pressed. The information is stored in a space called a "buffer", and you have the opportunity to look over the entry and make corrections if needed. When you are happy with it, press GO, which moves the entry from the buffer into the machines memory and/or executes it. (Execute meaning 'perform')
To create some sort of order, we generate a 'program' which is a total list of orders to the machine to tell it what to do, plus the permanent data it needs for the solution, and provisions for entering data of a variable sort.
To get to the program, one first starts with the step of 'naming the problem'. Then one makes up a 'flow chart' to get the general sequence of operations, and then finally the detailed program. When the program is printed (either on the screen or by hand,etc.,) it is 'listed', or you make a 'listing'.
Here is an example of the above in the addition of numbers, five in this case:

```
PROBLEM          ADD FIVE NUMBERS
FLOW CHART        [INPUT NUMBERS]
                        |
                   [ADD NUMBERS]
                        |
                  [PRINT ANSWER]

PROGRAM          INPUT A        GO
                 INPUT B        GO
                 INPUT C        GO
                 INPUT D        GO
                 INPUT E        GO
                 F = A + B + C + D + E      GO
                 PRINT F                    GO
```

(From now on, I won't print GO for every line entry, it should be a reflex.)

With the program shown above, the problem will work only once. To keep the program in the machine's memory, it is necessary to prefix each line with a 'line number'. These are usually shown in increments of 10 , as follows:

```
10   INPUT A
20   INPUT B
30   INPUT C
40   INPUT D
50   INPUT E
60   F = A + B + C + D + E
70   PRINT F
```

Now, to make it operate, you command RUN and then press GO which in this case makes it execute. The computer looks for the lowest line number, reads the instruction there, and reacts. When it has finished reacting, it looks for the next line number, reacts, etc.,etc.
You have probably noted that it does not make any difference in what order you enter line numbers, the machine will automatically put them in numerical order, a blessing.

In our example, line 10 says INPUT A so the internals of the machine, constructed by the engineer, decide that the keypad will provide a numerical value, and it will be identified as 'A' and placed in a memory slot, or "register" entitled A. It tells you this by printing the letter A on the screen followed by the cursor, indicating that it is waiting for you to pump in the first number. When you do,and follow it with GO, the machine has then completed its line 10 task and moves on to line 20. And so forth. At line 60 it sees that it has to set up a new register, F, and it must sequentially add the contents of registers A through E together, and place them in F. This job completed, it looks at line 70 and sees that it has to print the contents of F, which it does on the screen.

While the above is acceptable for a small number of input values, the program length(and therefore memory) can be prohibitive if you had the 26 maximum values you could enter (letter A - Z). In such instances, the FOR-TO loop is useful. We can also take advantage of being able to modify a register. The program is:

```
10 A = Ø
20 FOR B = 1 TO 5
30 INPUT C
40 A = A + C
50 NEXT B
60 PRINT A
```

(note that there are only 6 lines to the whole program.)

Analysis:

Line 10 is not really a part of the program, its intent is to make sure that there is no 'left-over' from some other program residing in A when you start. It is called "initialization".

Line 20 starts the FOR - TO loop, and eventually needs line 50 to make the loop work. The machine reads that you will make 5 entries. They will be numbered 1,2,3,4,5. It will not work if you have less than 5 entries (you may have to enter zeros to make up 5), and it will not accept more than 5. The numbering is arranged through a function called "STEP". If you don't define a value of STEP, the machine automatically picks "1". So, the value of B will start at 1 and automatically STEP by ones up to the value of 5.

Line 30 asks for inputs as before, but will always assign the input to register C (and wipe out what was there before).

Line 40 operates on register A in the modification mode as was mentioned above. What this says in English is that the New value in the A register is equal to the Old value in the A register plus the value in the C register. In the beginning of the program, the Old value in the A register is zero (Line 10). You now input C and in line 40 it calculates C + Ø so that now the New value of A is numerically C.

Line 50 completes the FOR-TO loop instruction. Now is the time for the value of B to change per the STEP function. The machine then goes on to line 30 again, and again,etc., until it runs out of B values, when it goes out of the loop and on to line 60.

Line 60 tells it to print whatever is in register A on the screen.

Lets add up the following numbers: 5, 12, 13, 26,6 in an extended example:

		loop	loop	loop	loop	
10	A=Ø					
20	B=1 (1<5)	B=2 (2<5)	B=3 (3<5)	B=4 (4<5)	B=5 (5=5)	B=6 (6>5)
30	C inputs 5	C inputs 12	C inputs 13	C inputs 26	C inputs 6	
40	5 = Ø+5	17 = 5+12	30 = 17+13	56 = 30+26	62 = 56+6	
50	B=2	B=3	B=4	B=5	B=6	
60						PRINT 62

While the FOR-TO loop saves space, it does so at the expense of loseing the identities of the inputted numbers. With the longer system, you could always call up a value, for example: PRINT D and the fourth value would show up. So each has its usage.
Suppose we want to make a small addition to the program, adding one line

```
25 PRINT B
```

Note that since we have used line numbers with an interval of 10, it is easy to slip the addition into the program. The keypad simplifies the 10 interval by having the +10 on the GO key - when you have finished a line, press WORDS +10GO and there it is.

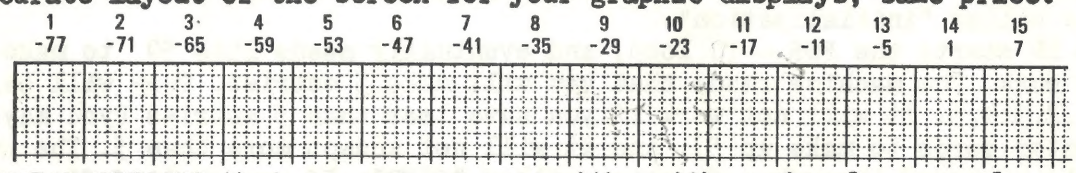
BANGMAN change was suggested by Rory Wohl as line 2000 was giving him some fits:

```
2000 E=E+1;IF E=9 GOTO 9000; IF Q≠ 1 GOSUB 9600 +(Ex10)
```

My machine worked fine the way it was, and would not work with this.

aMAZEd in SPACE game included in this issue is a rocketship-thru-the-maze challenge with a number of levels of difficulty. One problem is that I've lost the name of the originator. I sent the material to Dick Hauser who made a few modifications and prepared the descriptive material. Note how he has separated the listing into blocks that correspond with the flow chart. The program lines marked C are just for information and do not go into the machine.

PROGRAMMING SHEETS that I use in these issues are available from Chuck Thomka 1228 W 222 St. Torrance, CA 90502 at 20 for $1, add'l sheets at .05 each. He also has the GRAPHICS GRID per the sample shown, for those of you who need an accurate layout of the screen for your graphic displays, same price.



SPECIAL EFFECTS that you may come up with, either visual or aural, are requested. These would be short programs that give you a 'shot' sound, or a 'starburst', or similar enhancement that could be used in a game, etc. I would also keep these in a separate document, and probably make it available later, with an index.

TELEPHONE DATA COUPLER article in KILOBAUD, June '79 has been tried by B.Reany and found to be a workable unit. It uses a Radio Shack 43-230 telephone amplifier and a few parts

COLOR values requested in the last issue brought forth the following response from Don Wurst. "I used a Tektronix 520A vectorscope with a standard TV demodulator and found the following BC's to be as close as possible to the standards."

Luminance value Y	Color	BC
100	White	7
89	Yellow	126 or 134
70	Cyan	205 or 221
59	Green	172
41	Magenta	43
30	Red	82 or 90
11	Blue	249
0	Black	0

52=40

```
5 .SLOT MACHINE
6 .BY ERNIE SAMS
7 .4/1979
8 .
10 CLEAR;NT=1
15 GOSUB 3000
20 BOX -7,-2,134,64,1
30 BOX 61,0,6,4,1
40 BOX 65,10,3,24,1
50 BOX 67,22,6,10,1
52 BOX -7,-20,126,14,2
54 BOX -7,-20,124,12,1
56 BOX -7,-20,122,10,2
60 CX=-62;CY=-20
70 PRINT "ARCADE SLOT MACHINE",
80 BOX -50,15,42,14,2
82 BOX -50,15,40,12,1
84 BOX -50,15,38,10,2
86 BOX -8,15,42,14,2
88 BOX -8,15,40,12,1
90 BOX -8,15,38,10,2
92 BOX 34,15,42,14,2
94 BOX 34,15,40,12,1
96 BOX 34,15,38,10,2
100 M=0
200 N=KN(1)+128
210 N=N÷20; IF N>10 N=10
212 IF N<1 N=1
220 CX=-75;CY=40
230 PRINT "BET?",#3,N
240 IF TR(1)=0 GOTO 200
250 GOSUB 1000
260 GOTO 200
1000 FOR Y=27 TO 8 STEP -1
1010 BOX 67,Y,9,1,2
1015 BOX 67,Y-5,6,10,1
1020 NEXT Y
1030 FOR Y=8 TO 27
1035 BOX 67,Y-4,6,10,1
1040 BOX 65,Y,3,1,1
1045 BOX 69,Y-10,4,2,2
1050 NEXT Y
1060 NT=0
1070 FOR C=0 TO 4
1080 FOR B=0 TO 2
1090 D=RND(5)
1100 IF C=4 @(B)=D
1110 CY=15
1120 IF B=0 CX=-65
1130 IF B=1 CX=-23
1140 IF B=2 CX=19
1145 FOR Z=16 TO 22
1146 &(Z)=79
1147 NEXT Z
```

SLOT MACHINE

```
1150 IF D=1 PRINT "LEMON ",
1160 IF D=2 PRINT "CHERRY",
1170 IF D=3 PRINT "ORANGE",
1180 IF D=4 PRINT" BELL ",
1190 IF D=5 PRINT" BAR  ",
1192 FOR Z=22 TO 16 STEP -1;&(Z)=0;NEXT Z
1194 NEXT B
1195 NEXT C
1198 NT=1;L=M
1200 IF @(0)=1 GOSUB 2000;RETURN
1210 IF @(0)=@(1) IF @(0)=@(2) GOSUB 1300;RETURN
1220 IF @(0)=@(1) GOSUB 1400;RETURN
1230 IF @(0)=2 M=M+(2xN);GOSUB 1500;RETURN
1240 GOSUB 2000;RETURN
1300 IF @(0)=5 M=M+(18xN);GOSUB 1500;RETURN
1310 IF @(0)=4 M=M+(14xN);GOSUB 1500;RETURN
1320 IF @(0)=3 M=M+(10xN);GOSUB 1500;RETURN
1325 IF @(0)=2 M=M+(8xN);GOSUB 1500;RETURN
1330 GOSUB 2000;RETURN
1400 IF @(0)=4 IF @(2)=5 M=M+(12xN);GOSUB 1500;RETURN
1410 IF @(0)=3 IF @(2)=5 M=M+(8xN);GOSUB 1500;RETURN
1420 IF @(0)=2 M=M+(5xN);GOSUB 1500;RETURN
1430 GOSUB 2000;RETURN
1500 BOX 0,-40,150,8,2
1510 CX=-75;CY=-40
1512 M=M-N
1515 PRINT "YOU WON $", #3,M-L,
1520 GOSUB 2010
1522 FOR V=1 TO N
1525 &(19)=37;&(17)=31;&(21)=47;&(22)=31
1530 FC=83
1540 FOR U=30 TO 20 STEP -1;&(16)=U;NEXT U
1550 FC=0
1570 FOR U=20 TO 30;&(16)=U;NEXT U
1610 NEXT V
1620 FOR Z=22 TO 16 STEP -1;&(Z)=0;NEXT Z
1630 RETURN
2000 BOX 0,-40,150,8,2
2005 M=M-N;CX=-75;CY=-40;PRINT "SORRY",
2010 CX=5;PRINT "TOTAL $", #3,M,;RETURN
3000 PRINT "ARCADE SLOT MACHINE";PRINT
3010 PRINT "KNOB #1 LETS YOU BET FROM $1 TO $10.  PULL THE TRIG-"
3020 PRINT "GER TO PLACE YOUR BET."
3030 PRINT "THERE ARE LOTS OF WINNING COMBINATIONS.  A CHERRY IN THE
     LEFT WINDOW ALWAYS IS"
3040 PRINT "A WINNER; BUT A LEMON IN THE LEFT WINDOW NEVER WINS"
3050 PRINT "PRESS GO TO START PLAY.",
3060 K=KP;IF K=13 CLEAR;RETURN
3070 GOTO 3060
```

SLOT MACHINE DOCUMENTATION:

	Lines	
	10 - 96	Instructions and set up slot machine.
	100	If a new game is started make Money equal to 0.
	200 - 240	Bet from $1 to $10 with knob #1.
	250	Start "play" routine
	260	Play is complete go back to 200 for another bet.
	1000 - 1050	Pull slot machine handle routine.
	1070	Display 5 sets of words.
	1080	In 3 boxes.
	1100	Store the number that counts in the proper storage location.
	1110 - 1140	Print the words in the appropriate position.
	1145 - 1147	Set up a sound for the slot machine.
	1150 - 1190	Print the appropriate words generated by the random number in 1090.
	1192	Reset all noisemakers to 0.
	1198	L establishes the amount of money won or lost as of the last play. Is used in 1515.
Determine what is displayed in windows	1200	If the first word (left window) is "lemon" goto loser routine.
	1210	If all three words are the same go to three-of-a-kind winner routine at 1300.
	1220	If the program reached this statement there was neither a lemon in the first position nor three-of-a-kind. So, if there is two-of-a-kind go to possible winner routine at 1400.
	1230	If none of the above but the word "cherry" is in the left window increment the Money counter by two times the amount of the bet. Go to the winner routine at 1500.
	1240	None of the above so had to be a loser. Go to loser routine at 2000.
Three-of-a-kind	1300	Three "bar"s pay 18 times the bet.
	1310	Three "bell"s pay 14 times the bet.
	1320	Three "orange"s pay 10 times the bet.
	1325	Three "cherry"s pay 8 times the bet.
Two-of-a-kind	1400	Two "bell"s and a "bar" in the right window pay 12 times bet.
	1410	Two "orange"s and a "bar" in the right window pay 8 times bet.
	1420	Two "cherry"s and a "bar" in the right window pay 5 times bet.
	1430	If right position is not a bar go to loser routine.
Winner Routine	1500	Blank out old message.
	1512	Reduce current win by amount of bet.
	1515	Display current win.
	1520	Display current total Money.
	1522-1610	Sound siren and flash lights the number of times of the bet.
	1620	Reset noisemakers to 0.
Loser Routine	2000	Blank out old message.
	2005	Reduce current total by amount of bet.
	2010	Return to 260 for another bet.

PROGRAM NAME: AMAZED IN SPACE	PROGRAM OUTLINE:	PROGRAM DESCRIPTION: Maneuver spaceship thru maze without crashing into walls. Direction is controlled by Joystick 1. Path size, maze height, maze width and degree of difficulty are selected by Keyboard input. Score is based on these inputs and time taken to complete maze. It takes quite awhile to complete maze interior, so start small.	COMMENTS ON PROGRAM: See Flowchart
Written By:	Type: MAZE		
Address:	Opponent: SKILL		
	Length: As Desired		
Telephone #	Controls Used: Keyboard, Joystick		
Adapted From:	Graphics? Yes		Variables Used: J,R,L,H,A,X,Y,P,Q A,C,T,D,E,M,N,G,S, @(1), @(2), Z
Revised by R. M. Houser 415-447-8493	Memory Left SZ: 48		

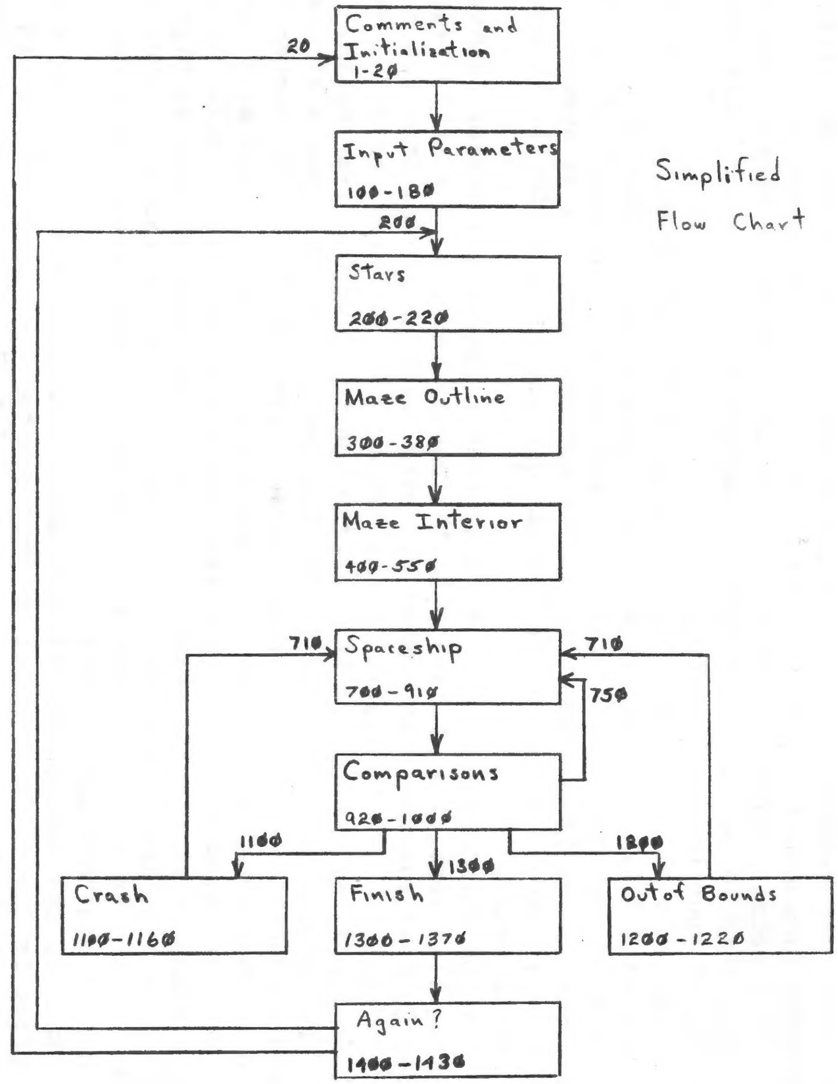
```
Line #  Statement(s)
1    .
2    .
3    .
4    .
5    .AMAZED IN SPACE
6    .BY AQUILA
7    .REVISED BY
8    .R M HOUSER

10   J=Ø
20   NT=Ø;CLEAR;BC=Ø;FC=126

C    INPUT STATEMENTS
100  INPUT "DEGREE OF DIFFICULT
     Y?     Ø-EASY  1-MEDIUM  2
     -HARD "R;CLEAR
110  PRINT "PATH SIZE CAN BE FR
     OM     ",#3,5+R," TO 2Ø"
120  INPUT "PATH SIZE?"L;CLEAR
130  PRINT "HEIGHT CAN BE FROM
     2 TO ",36÷L
140  INPUT "HEIGHT?"H;@(2)=L×H;
     CLEAR
150  IF @(2)>36 GOTO 130
160  PRINT "WIDTH CAN BE FROM 2
      TO ",74÷L
170  INPUT "WIDTH?"W;@(1)=L×W;C
     LEAR
180  IF @(2)>74 GOTO 160

C    STARS
```

```
Line #  Statement(s)
200  CLEAR;FOR A=1 TO 1ØØ
210  X=Ø;Y=Ø
220  BOX RND (16Ø)-8Ø,RND (88)-
     44,1,1,1;NEXT A

C    MAZE OUTLINE
300  BOX Ø,Ø,2×@(1)+8,2×@(2)+8,2
310  LINE -@(1),@(2),4
320  LINE @(1),@(2),1
330  LINE @(1),-@(2)+L,1
340  LINE @(1),-@(2),4
350  LINE -@(1),-@(2),1
360  LINE -@(1),@(2)-L,1
370  LINE -@(1),@(2),4
380  LINE X,Y,4

C    MAZE INTERIOR
400  P=(W×H×(1ØØ÷L))
410  FOR Q=1 TO P
420  A=(RND (3)-2)×L
430  B=(RND (3)-2)×L;X=X+A
440  IF X<-@(1) X=@(1)
450  IF X>@(1) X=-@(1)
460  IF PX(X,Y)=1 LINE X,Y,4
470  LINE X,Y,1;Y=Y+B
480  IF Y<-@(2) Y=@(2)
490  IF Y>@(2) Y=-@(2)
510  IF PX(X,Y)=1 LINE X,Y,4
520  LINE X,Y,4;P=P-1
530  CY=4Ø;PRINT "COUNTDOWN=",#
     2,P
540  NEXT Q
550  CY=4Ø;PRINT "                "
```

```
Line #  Statement(s)
C    SPACESHIP
700  C=Ø;T=Ø
710  X=-@(1)-2
720  Y=@(2)-(L÷2);M=Ø;N=Ø
740  &(23)=255;BC=0
750  D=JX(1);E=JY(1)
760  M=M+D;N=N+E
770  G=3
780  IF M>G M=G
790  IF M<-G M=-G
800  IF N>G N=G
810  IF N<-G N=-G
820  X=X+M;Y=Y+N
830  IF D#Ø&(21)=255
840  IF E#Ø&(21)=255
850  IF D=ØIF E=Ø&(21)=Ø
860  T=T+1;CY=44;PRINT #4,T
870  BOX X,Y,3,3,3
880  BOX X-D,Y-E,1,1,3
890  BOX X-D,Y-E,1,1,3
910  BOX X,Y,3,3,3

C    Comparisons
920  IF PX(X,Y)=1GOTO 11ØØ
930  IF PX(X+R,Y+R)=1GOTO 11ØØ
940  IF PX(X+R,Y-R)=1GOTO 11ØØ
950  IF PX(X-R,Y+R)=1GOTO 11ØØ
960  IF PX(X-R,Y-R)=1GOTO 11ØØ
970  IF X>@(1)IF Y<-@(2)+L &(21
     )=Ø;GOTO 13ØØ
980  IF X<-@(1)IF Y<@(2)-L &(21
     )=Ø;GOTO 12ØØ
990  IF X<-@(1) IF Y>@(2)&(21)=Ø
1000 GOTO 75Ø
```

Line #	Statement(s)	Comments
C	CRASH	
11ØØ	&(21)=Ø;C=C+1	J- Last Score
111Ø	CX=-75;CY=44;PRINT C," CRA	R- Degree of Difficulty
	SH!"	L- Path Size
112Ø	FOR A=1TO 25;BC=8Ø;NT=5	H- Maze Height x 2
114Ø	MU="4";NEXT A	W- Maze Width x 2
116Ø	NT=Ø;GOTO 71Ø	X - Spaceship X Location
		Y - Spaceship Y Location
C	OUT OF BOUNDS	P- # of loops to
12ØØ	NT=5;CY=44;PRINT "OUTER LI	complete maze
	MITS--OFF LIMITS";NT=Ø	interior, on large
121Ø	CY=44;PRINT "	mazes can take
	"	15-20 minutes to
122Ø	GOTO 71Ø	complete.
		C - Crashes
C	FINISH	M - X velocity
13ØØ	NT=3;CLEAR	N - y velocity
132Ø	PRINT "FAR OUT!, YOU DID IT	D - JX input
	!;ONLY",#3,C," CRASH(ES)!	E - Jy input
	"	G - max movement
133Ø	PRINT "TIME=",#5,T	per loop, if any
134Ø	S=((R+1)xHxW)x72÷((TxL)÷1Ø	larger spaceship
	)x1Ø	will jump lines
135Ø	PRINT "SCORE=",#5,S	without crashing
136Ø	IF S>J J=S	S - Score
137Ø	PRINT "TODAY'S HIGH SCORE=	Z - Again Input
	",#5,J	A,Q loops
C	TO PLAY AGAIN	
14ØØ	PRINT "AGAIN?"	
141Ø	NT=Ø;INPUT "1-YES 2-SAME	
	AS LAST GAME"Z	
142Ø	IF Z=1 GOTO 2Ø	
143Ø	IF Z=2 GOTO 2ØØ	
	;RETURN	

Simplified Flow Chart



R.M.H.

TUTORIAL 2 - The Music Synthesizer, by Chuck Thomka

The synthesizer circuit, which is contained wholly within the 40 pin custom I/O chip, is a very versatile circuit which contains counters and amplifiers to give the programmer tremendous control of the three voice output along with a tremolo, vibrato, and even a noise generator. The output frequency range is very accurately adjustable from less than 14 hertz to ultrasonic frequencies. The upper limit may be set by the capacity of your tv sound system.

Toward the end of this article I'll give you some examples of figuring out an accurate oscillating frequency, and two programs. One to play the entire synthesizer via the &(16) through &(23) registers , and the other to simulate the Bell Telephone Touch Tone sound. By holding a telephone mouthpiece at the tv speaker, you can dial a telephone number. Refer to the logical diagram included to fix in your mind just what is happening.

The operation goes like this. The clock triggers the Master Counter which counts, starting from zero, the pulses up to the number set into the &(16) register. When the Master Counter reaches that number, it puts out a pulse and then the counter will either reset to zero or preset to the number from the &(20) or &(23) register (these will be explained later) and then starts the count up all over again.

The pulse coming from the Master Counter goes to the inputs of the identical A, B, and C Counters. While all three counters are identical, the number that each counts up to is individually adjustable by using the &(17),&(18), and &(19) registers.

Each of these counters, upon reaching its count number, will "toggle" its output. Toggle means to change its output once; if it was low, it will go high and if it was high it will go low. Since the counter has reached its assigned count level, it will reset to zero at the next pulse from the Master Counter and start counting up again so that it can once again toggle.

Each of the outputs of the A,B, and C Counters goes to its own amplifier. That amplifier is the volume control of that counter (or voice) and it has 16 levels of output. While the lowest level isn't absolutely zero, it is almost inaudibly low. The &(22) register controls Volume A (the four least significant bits (=LSB)) and Volume B (the four most significant bits (=MSB)) while half of register &(21) (the four LSB) controls Volume C.

There is one more amplifier. The is the Noise Volume. But it must be 'enabled', to work. (that is, turned on) Only one bit is the enable, bit 32 of the &(21) register. This bit must be high for the Noise Generator to be heard at the volume setting of the &(23) register (the four MSB).

&(20) is the Vibrato control register. What it will do to the final audio output is make the sound shift from one frequency to another frequency at a set rate (1 of 4). This makes it very useful for sound effects. How it does this is by not allowing the Master Counter to reset to zero once the Master Counter has reached the &(16) value. Instead, at that time, on the following clock the Master Counter will preset to the value set into the 6 LSB's of the &(20) register. This means instead of the next count cycle of the Master Counter starting at zero, it will start at some number from 0 to 63. This could greatly reduce the time required for the Master Counter to reach its &(16) value. For example, if the &(16) is set to 14, which would normally take 15 clocks (0 to 14 is 15), and the 6 LSB's of the &(20) were set to 10, then this would triple the normal output frequency. This is because now the Master Counter would only have to count from 10 to 14, a total of five clocks, or three times faster than normal.

I mentioned a rate selection of 1 out of 4 choices that the Vibrato will 'vibrate' at. This is selected by the remaining 2 bits of the &(20) register, the 2 MSB's. The four combinations of these 2 bits are 00,01,10, and 11, in increasing value. These rates are (approximately) 18.5 milliseconds,37 milliseconds,74 milliseconds, and 148 milliseconds, respectively. What happens during this rate time is that for rate 00 the Master Counter will work normally and be allowed to count up to its determined value and then reset to zero for a period of 18.5 milliseconds; then, for the next 18.5 milliseconds the counter will not reset to zero but instead preset to the value of the 6 LSB's in the &(20) register. Of course, if that value is also zero (000000) then there is no difference between reset and preset, hence no vibrato. Each of the other rate selections work in a similar manner except that the duration of normal count time and preset count time will be longer, which is a slower vibrato effect.

My wording earlier was that this present value could greatly reduce the time required for the Master Counter to reach its &(16) value. It is also possible that the preset value could greatly increase the time, thus making the vibrato shift in audio frequency go lower instead of higher. This is possible when the vibrato value (range 0 to 63) is set to a higher value than the number in the &(16) register. For example, in my previous example I had &(16) set to 14 (or 15 counts) and the 6 LSB's of &(20) set to 10, showing that the resultant vibrato shift would be three times greater than normal. Now in this new example lets have &(16) still at 14 and put &(20) (the 6 LSB's) to 15. During the time of vibrato preset operation, when the Master Counter finally gets to 14, its determined value, at the next clock the counter will preset to 15. The counter has no way of knowing that it is now at a count greater than its determined value, it is still looking for the value 14, and 15 is not 14 - so as the counter receives more clock pulses it will continue to count up. And up to count 255 (binary 11111111) it continues. The next clock will overflow the counter to zero (no provisions for carryover are made) and still continue - 1, 2, 3, etc. And it finally reaches count 14 to output the Master Counter Pulse. The next clock repeats the reset to 15 and another long count, "round the horn", to 14. So how many clock pulses does this take? Well, counting 15 to 255 is 241, plus 0 to 14 is an additional 15 for a total of 256. Instead of the normal reset time of 15 clocks, the preset time will take 256 clocks in this example, or over 17 times longer. The longer time for the output pulse from The Master Counter results in a much slower rate of toggling of the A, B, and C counters, which results in a much lower output (voice) frequency.

A Tremolo would be a warble effect in the tone of a note. This is controlled by &(23), but it must first be enabled by &(21) bit 16. This bit acts like a switch. When it is off, &(20) -the Vibrato Register- can be engaged. If &(21) bit 16 is on, the Vibrato will not work and the Tremolo register is engaged. The Tremolo and Vibrato cannot be engaged at the same time, but as you become more familiar with the sounds out of the Sound Synthesizer, and their ranges, you'll see it is not really necessary anyway.

The operation of the Tremolo is similar to the Vibrato in that it also presets the Master Counter to some number before it starts its count. But, whereas the Vibrato had a rate control (the period of which the counter would alternately reser or preset), the Tremolo always presets. The number to which it is preset is randomly selected and only limited to a maximum numner as set into &(23). All eight bits of &(23) are used for the Tremolo preset. But remember that the four highest bits are also used for the Noise Volume, in case you try to use the Noise along with the Tremolo. Also remember that the Noise is switched in by &(21)bit 32.

The preset of a number into the Master Counter, if it is less than the &(16) determined value of the Master Counter, will shorten the time involved in reaching that &(16) value. The result will be an upward shift of the resultant A, B, and/or C frequency or pitch, and the next preset will be another randomly selected value (up to the maximum of &(23)). The audible result of all this will be a tremble or quivering effect. If the &(23) value is greater than the Master Oscillator's &(16), the resultant may be a random long count 'round the horn' for the same reason that the Vibrate could have a long count. The audible effect wll be a wildly varying Tremolo sound. One last remark about the Tremolo is that if &(23) is set to zero, there will be no Tremolo effect at all since a random preset of up to zero can only be zero, and that is the same as a reset of the Master Counter.

Now lets get into how to figure out a simple set of frequencies. First, the key to the whole thing is to know what the main clock frequency is. I am using a frequency of 1,777,940 hertz for all my figures, measured on pins 16 and 20 of the I/O chip after some warmup. The reciprocal of this frequency is 0.562448 microseconds. This is the unit of time that the Master Counter counts. This should be 1/8 of the crystal oscillator frequency (supposed to be 14,318,180 hertz) but the error in my unit is -.0018% , a quite acceptable figure.

For some practice, here are some parameters:

&(16) = 60	Master Counter
&(17) = 99	Counter A
&(18) = 74	Counter B
&(19) = 49	Counter C

Forgetting for the moment the Vibrato, Tremolo,Noise and Volume controls, I want to show you what the resultant A, B, and C voices would be. First remember that all of these counters start at count zero, which is one less than you or I count on our fingers. Second, since the period of total time it takes for the A, B, or C counter to toggle is only one change of state, it will take yet another toggle to equal one cycle of some resultant frequency. This is why you will find a 2 in the figures below.

Use this formula: (Substitute counter B or C when calculating those frequesncies)

$$\text{Freq. A} = \frac{1}{(\text{Master Counter}+1) \times (\text{counter A} + 1) \times \text{Time Unit} \times 2}$$

This converts to:

$$\text{Freq. A} = \frac{1}{61 \times 100 \times 0.562448 \times 10^{-6} \times 2} = 145.7 \text{ hertz}$$

$$\text{Freq. B} = \frac{1}{61 \times 75 \times 0.562448 \times 10^{-6} \times 2} = 194.3 \text{ hertz}$$

$$\text{Freq. C} = \frac{1}{61 \times 50 \times 0.562448 \times 10^{-6} \times 2} = 291.4 \text{ hertz}$$

So there are three different frequensies, all available at one time, by simply turning on the A,B, anc C volumes. Notice that while Counter A + 1 is twice the value of Counter C + 1, the resultant frequencies have Freq. C twice the value of Freq. A. This is because Counter A has to count twice as many Master Pulses, before toggling, as Counter C does.

Now all that is useful if you are trying to find the resultant frequency for some known values, but we usually want to go the other way. As an example, we will see the steps to find the values need to generate the Bell System Touch Tones, the number "0". Bell Systems require two frequencies outputted whenever one key is pushed on their regular pad. When pushing "0" the two frequencies are supposed to be 1336 and 941 hertz, with an acceptable tolerance of ± 5 hertz. Calculate Freq.A values for 1336 hertz and Freq. B values for 941 hertz:

Step 1 Find the reciprocal of the frequency
Step 2 Divide the reciprocal by the Time Period
Step 3 Divide by 2, and use the nearest whole number. Th is answer is the total number of time periods that must be counted before having an output toggle for the frequency's half cycle.

For Freq. A, 1 divided by 1336 divided by 0.562448×10^{-6} divided by 2 =665.39 =665
For Freq. B, 1 divided by 941 divided by 0.562448×10^{-6} divided by 2 =944.7 =945

The values of 665 and 945 are the total number of clock periods as mentioned above. But recall that the Master Counter must count some of those clocks, and it sends a pulse to both A and B Counters, so it must count a number of clocks which have a common denominator to 665 and 945. For ease, I have set the Master Counter to count 5 clock periods before sending out that pulse, so &(16) = 4 (0,1,2,3,4 = 5)
Now that means Counter A must be set to 665/5=133, therefore &(17)=132. And Counter B must be set at 945/5=189, therefore &(18)=188.

If you run these results back through the first formulas, you will find that Freq A = 1336.8 hertz and Freq B = 940.7 hertz, well within the tolerance band.

To have both voices come from the tv speaker at the same time only requires that Volume A and Volume B be brought up to sufficient numbers. Both would be maximum if &(22) is set to 255.

I have found two exceptions that may be unique to my own computer... One, when &(16) is set to 0, it recognizes it as 2; and the other is when &(16) is set to 1, it recognizes it as 3. I can't explain why, it may have to do with the high speed at which you are trying to make the Master Counter work.

Load the "SOUND GRAPH" program and get some 'hands on' experience, and try out different ideas. Also, there is an optional modification to the program that will display all eight binary bits of the value that the knob is adjusted to at that time. It does slow down the program, but it is a good teaching aid.

PROGRAM NAME SOUND GRAPH

Line #	Statement(s)	Comments
4	:RETURN	
5	.SOUND GRAPH	
6	.CHUCK THOMKA 28AP79	
10	CLEAR;NT=Ø	
20	FOR A=16TO 23	
30	PRINT #1,A;NEXT A	
40	M=KN(1)+128	ADJUSTS FOR KNOB RANGE
50	IF M=V GOTO 90	IF M NOT CHANGED JUMP
60	V=M	
80	Y=-32;GOSUB 200	
90	L=L-JY(1)	
100	IF L<1 L=1	
110	IF L>8 L=8	
120	Y=48-8×L	
130	BOX -74,Y,12,7,2	ERASES (FLASHES) & COMMAND
140	CX=-77;CY=Y	
150	PRINT #1,15+L,	REPRINTS & COMMAND #
160	IF TR(1) GOSUB 200;&(1	IF TRIGGER PULLED CHANGE
	5+L)=V	& COMMAND VALUE
170	GOTO 40	
200	BOX 6,Y,148,7,2	ERASES OLD LINE & NUMBER
210	IF V÷2=ØGOTO 230	
220	BOX V÷4-68,Y,V÷2,3,1	DRAWS NEW LINE
230	CX=64;CY=Y	
240	PRINT #1,Y;RETURN	PRINTS NEW NUMBER

THIS IS OPTIONAL

Line #	Statement(s)	Comments
70	GOSUB 300	IF YOU WANT TO SEE A
300	CY=-40;B=Y	BINARY REPRESENTATION
310	FOR F=10TO 3 STEP -1	OF THE NUMBER IN
320	CX=-77	THE VALUE REGISTER.
330	B=B÷2	
340	PRINT #F,RM,	
350	NEXT F	
360	RETURN	

PROGRAM NAME TOUCH TONE SIMULATE

Line #	Statement(s)	Comments
4	:RETURN	COMMANDS ARE "PRINT", "CLEAR"
5	.TOUCH TONE SIMULATE	AND "ERASE". THESE WILL
6	.CHUCK THOMKA 28AP79	
10	CLEAR	
20	A=Ø	
30	NT=3;N=KP	
40	IF N=116GOTO 110	PLAY NUMBERS IN MEMORY
50	IF N=105GOTO 10	CLEAR MEMORY
60	IF N=31A=A-1;GOTO 90	ERASE ONE NUMBER
70	A=A+1	
80	@(A)=N	PUT NUMBER IN MEMORY
90	TV=N,	
100	GOTO 30	
110	NT=Ø;PRINT	
120	FOR D=1TO A	
130	TV=@(D)	
140	GOSUB 252+@(D)	GET FREQ FM. TABLE
150	&(17)=C;&(18)=R	SET IN NEW FREQS.
160	&(16)=4;&(22)=255	SET MASTER OSC. & VOLUME
170	FOR T=1TO 75	PLAY NUMBER LOOP
180	NEXT T	
190	&(22)=Ø	SHOT OFF SOUND
200	NEXT D	NEXT NUMBER TO DIAL
210	GOTO 30	
300	C=132;R=188;RETURN	0= 1336.8 HZ & 940.7 HZ
301	C=146;R=254;RETURN	1= 1209.5 HZ & 697.2 HZ
302	C=132;R=254;RETURN	2= 1336.8 HZ & 697.2 HZ
303	C=119;R=254;RETURN	3= 1481.6 HZ & 697.2 HZ
304	C=146;R=230;RETURN	4= 1209.5 HZ & 769.7 HZ
305	C=132;R=230;RETURN	5= 1336.8 HZ & 769.7 HZ
306	C=119;R=230;RETURN	6= 1481.6 HZ & 769.7 HZ
307	C=146;R=208;RETURN	7= 1209.5 HZ & 850.7 HZ
308	C=132;R=208;RETURN	8= 1336.8 HZ & 850.7 HZ
309	C=119;R=208;RETURN	9= 1481.6 HZ & 850.7 HZ

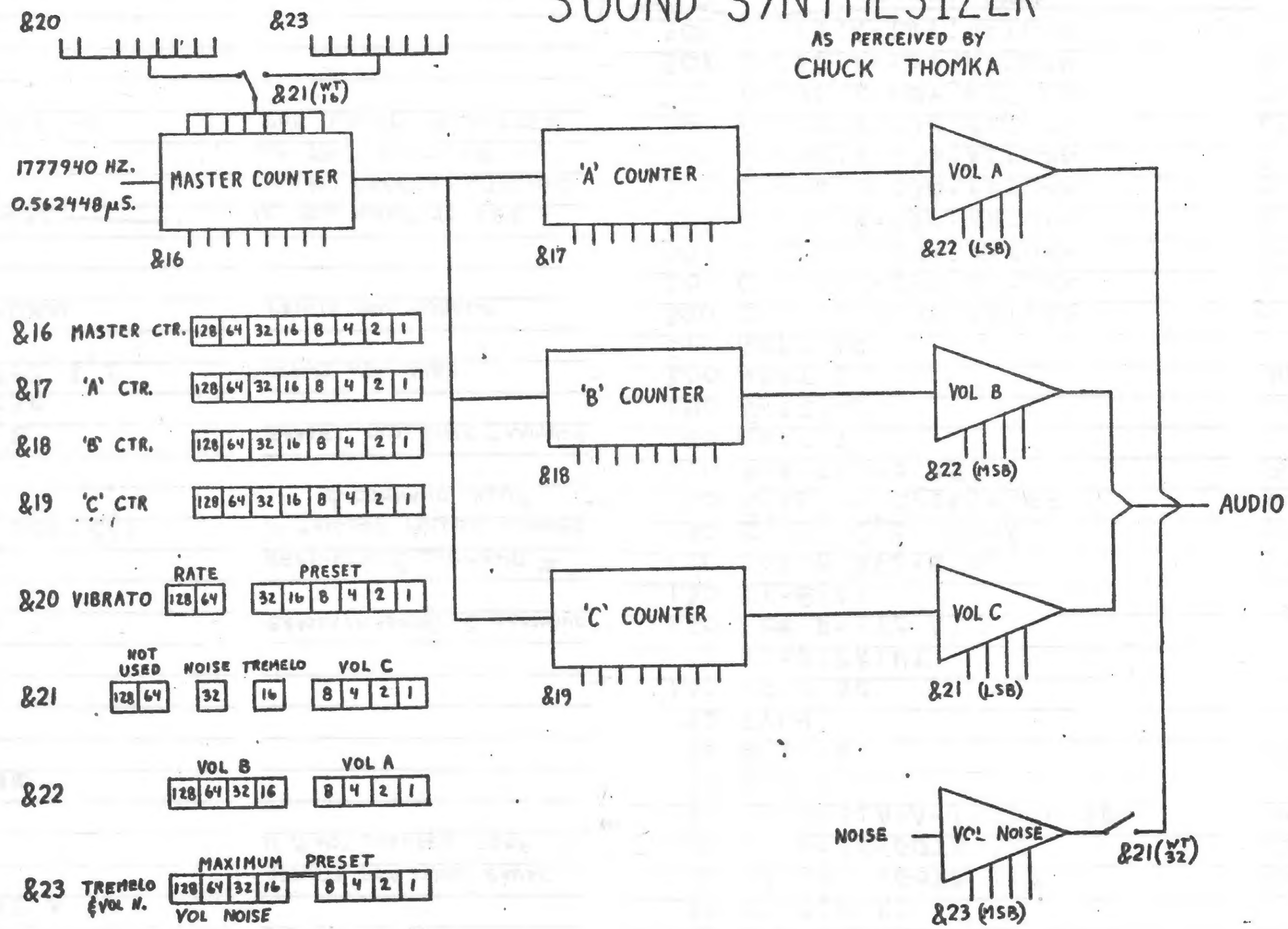
BELL SYSTEMS REQUIRED FREQ. GRID

	COLUMN FREQS				ROW FREQS
	1209	1336	1477	1633	
	1	2	3	A	697
	4	5	6	B	770
	7	8	9	C	852
	*	0	#	D	941

ONE COLUMN FREQ AND ONE ROW FREQ PER NUMBER PUSHED. ALSO I'VE ADDED A TO D IF YOU HAVE THE 16 KEY KEY-PAD PHONE

THE SOUND SYNTHESIZER

AS PERCEIVED BY
CHUCK THOMKA



PROGRAM NAME Memory Display — Page 1 of 1

Line #	Statement(s)	Comments
4	:RETURN	THIS IS A NICE MEMORY DUMP
5	.MEMORY DISPLAY	PROGRAM THAT DISPLAYS
6	.CHUCK THOMKA 4APR79	THE DECIMAL AND HEXADEC-
1Ø	INPUT "FIRST LOCATION	IMAL LOCATION NUMBERS
	# ="F	(ADDRESS) AND DATA. IT
2Ø	INPUT "LAST LOCATION	WILL DO WHOLE BLOCKS
	# ="L	OF DUMPS BY GIVING A
3Ø	INPUT "STEP AMOUNT ="	STARTING AND ENDING
	S	ADDRESS. IT WILL INCRE-
4Ø	FOR N=FTO LSTEP S	MENT THE ADDRESS BY THE
5Ø	PRINT #6,N,#1," %",	ENTERED AMOUNT IF YOU
6Ø	E=N;GOSUB 2ØØ	ONLY WANT TO CHECK
7Ø	H=%(N)	EVERY 1000TH LOCATION,
8Ø	PRINT #1," =(",	FOR EXAMPLE.
9Ø	E=H;GOSUB 2ØØ	
1ØØ	PRINT #1,")",#6,H	
11Ø	NEXT N	
12Ø	GOTO 1Ø	
2ØØ	S=Ø	
21Ø	IF E<ØE=E+32767+1;S=8	
22Ø	E=E÷16;D=RM	
23Ø	E=E÷16;C=RM	
24Ø	E=E÷16;B=RM	
25Ø	A=E+S	
26Ø	E=A;GOSUB 4ØØ	
27Ø	E=B;GOSUB 4ØØ	
28Ø	E=C;GOSUB 4ØØ	
29Ø	E=D;GOSUB 4ØØ	
3ØØ	RETURN	
4ØØ	IF Ø<=E IF E<1ØPRINT	
	#1,E,;RETURN	
41Ø	TV=55+E;RETURN	
		USE NEGATIVE LOCATION
		NUMBERS TO CHECK THE
		UPPER MEMORY.
		$-32767_{10} = 8001_{16}$
		TO
		$-1_{10} = FFFF_{16}$

USE OF SPACE ... IS FOR 2ND OR MORE LINES OF MULTI-LINE STATEMENTS

Line #	Statement(s)	
1	.>SQUARE ROOT<	
2	.BY DAVID STOCKER	
1Ø	INPUT S	
2Ø	A = S÷2	
3Ø	FOR T=1TO 1Ø	
4Ø	IF A=Ø A=1	
5Ø	B=S÷A	
6Ø	IF A=B GOTO 1ØØ	
7Ø	A=(A+B)÷2	COMMENTS
8Ø	NEXT T	
1ØØ	PRINT A,B	A WILL = B ±1 (ERROR)
11Ø	PRINT A×B	
12Ø	PRINT A×B-S	OPTIONAL
13Ø	PRINT S	
1	.>DISTANCE BETWEEN	
	TWO POINTS<	
2	.BY DAVID STOCKER	
1Ø	CLEAR;PRINT;PRINT	
2Ø	INPUT X	POINT 1
3Ø	INPUT Y	
4Ø	INPUT "X" V	POINT 2
5Ø	INPUT "Y" W	
6Ø	BOX X,Y,1,1,1	
7Ø	BOX V,W,1,1,1	
8Ø	P=(X-V)×(X-V)+(Y-W)×(Y-W)	
9Ø	A=P÷2	
1ØØ	FOR T=1TO1Ø	
11Ø	IF A=Ø A=1	
12Ø	B=P÷A	
13Ø	IF B=A GOTO 2ØØ	
14Ø	A=(A+B)÷2	
15Ø	NEXT T	
2ØØ	PRINT A,B	A WILL = B ±1 (ERROR)

DO NOT ENTER A SPACE BETWEEN LINE # AND STATEMENT, THIS IS DONE BY THE UNIT

ADS

- o Bally Basic cartridge,manual, interface package,SEAWOLF/MISSILE,BRICKYARD/CLOWNS for $80. M. Jones 11106 Polaris San Diego,CA 92126 714-566-8087
- o CHESS for two players $6 on my tape or $5 on yours. Add $2 for CHECKERS or HANGMAN on reverse. J.Collins 713 Bradford Dr. Ft.Walton Beach FL 32548
- o Program listings available from Ron Schwenk,6988 Lincoln Creek Circle,Carmichael CA 95608 - Mastermind/Batnum at .20 each, Craps at .10, Legal stamped envelope,please
- o SEA BATTLE @4./HORSERACE,STARSHIP,ROBOT WAR @3.each/STAR WARS,SLOT MACHINE,STARTREK, CRAPS 2,CONNECT 4 @2.each/TICTACTOE @1. Above on your tape,4 min per program,half price for listing alone.All ten for $22. All except Connect 4 have graphics. Scott Waldinger 24740 Woodcroft Dr. Dearborn MI 48124

BOOKS that have been recommended by subscribers are: A GUIDED TOUR OF COMPUTER PROGRAMMING IN BASIC by Dwyer and Kaufman, and 57 PRACTICAL PROGRAMS & GAMES IN BASIC by Tracton. I have received a couple of programs that were modified from the latter.

SERVICES AVAILABLE form Tim Hays, 456 Granite Ave, Monrovia CA 91016 include: piano-like 3-octave keyboard; hard wired TBASIC chip into motherboard with switch; Sound output; special application software, games, music, sound effects, also sales of Bally hardware. Send for details 213-359-8092

VARIETY is offerred by W&W Software Sales, 6594 Swartout Rd. Algonac MI 48001. Five pre-programmed tapes with 5 programs each at $10 each tape. Guaranteed bug-free. Include boards for games, colors, skill levels, busin ess programs. Send S.A.E.

THIS ISSUE is pretty well packed with stuff, primarily your contributions of one kind or another. I have received a lot of compliments on the paper, but I am only relaying the material that comes in to me, so the compliments really go right back out to you, the subscribers. On the other hand, "keep those cards and letters comin' ", so that we can all benefit in this endeavor.

REWORKED GAMES mentioned above also have been taken from 24 TESTED, READY-TO-RUN GAME PROGRAMS IN BASIC by Tracton (The Tracton books are distributed by TAB books) and from BASIC COMPUTER GAMES by Ahl, editor of Creative Computing magazine. A recommended book is THE BASIC COOKBOOK by Tracton, a dictionary type of book. These have been reported by Bob Kelley.

68

50

ARCADIAN
Robert Fabris, folder
3626 Morrie Dr.
San José, CA 95127

Brown unknown

Basic cartridge

#1 INPUT

C/S/T

FIRST CLASS

9455CHUS0635L
R. HAUSER
635 LOS ALAMOS AVENUE
LIVERMORE, CA 94550